Powering Innovation That Drives Human Advancement

TwinFlow JIP Proposal

Callum Williams-York

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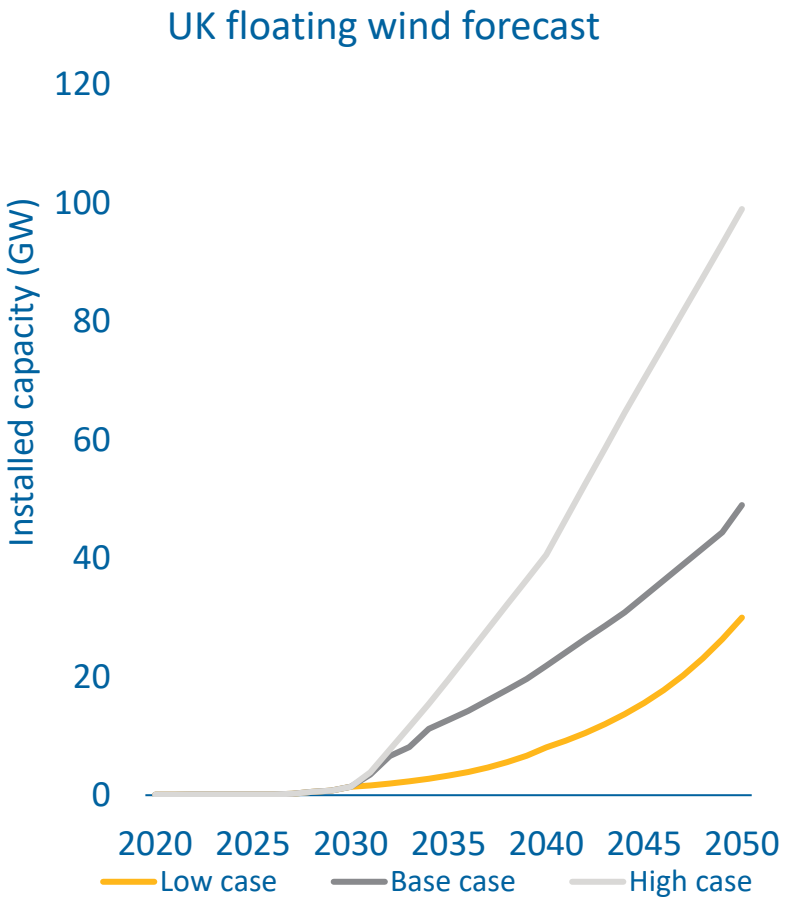
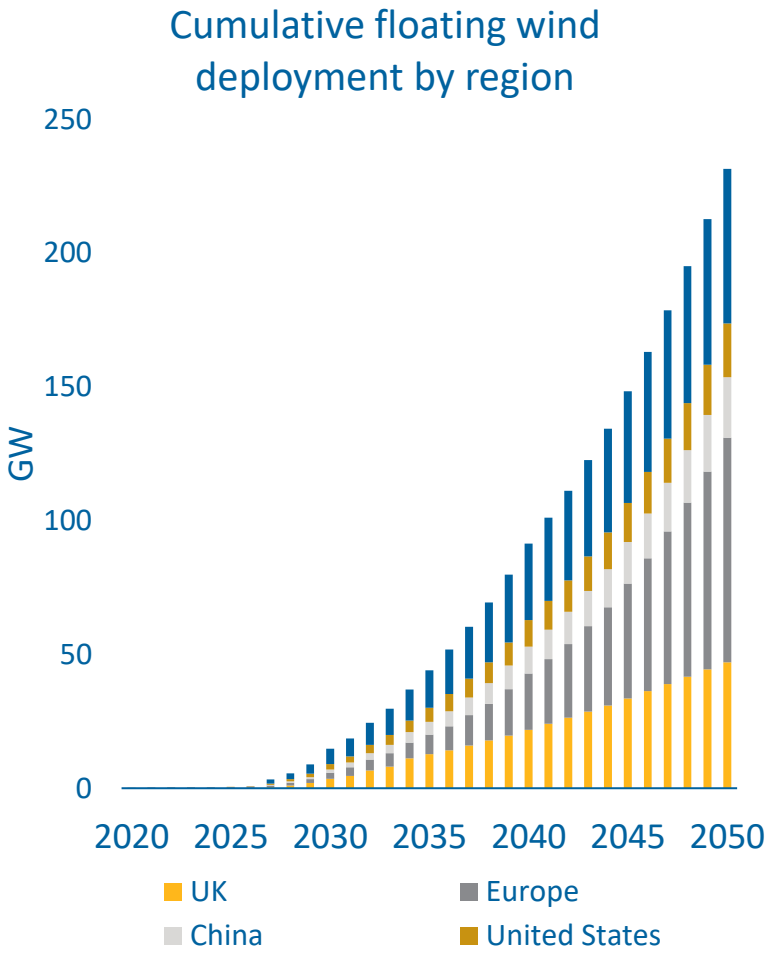
Introduction - Problem





- Floating wind is expected to take off from a standing start
- Assets in the field will need to be maintained with detailed inspection and monitoring often expensive
- Digital twins can optimise maintenance schedules and extend operation life
- Analysis methods for floating offshore wind are advancing rapidly but remain unvalidated
- There are a wide variety of floating platforms with challenging hydrodynamic and stability characteristics to simulate

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TwinFlow - JIP Proposal

- The term "digital twin" often sparks confusion

- Our JIP's interpretation of a digital twin goes beyond these idea:
  - Dynamic representation of both the full FOWT and its environment
  - Designed to mirror real-world performance
  - Adapt over time.

- Our proposed digital twin, combined with a set of clear guidelines, will create a reusable, adaptable framework for future floating offshore wind projects.

- Built using ANSYS and other commercially available tools, this standardised workflow will ensure consistency and efficiency, with minimal need for customisation, across a range of applications.

Ansys

apollo

CATAPULT
Offshore Renewable Energy

Net Zero Technology Centre
Technology Driving Transition

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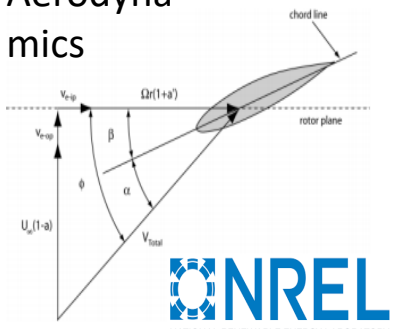
Solution – Simulation Driven Digital Twin

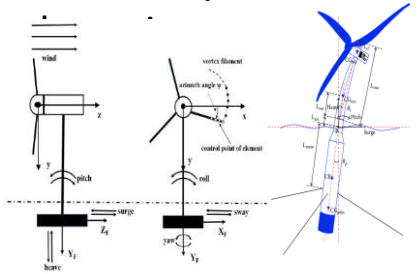
Simulation

High-fidelity accurate simulation of FOWT

Aerodynamics



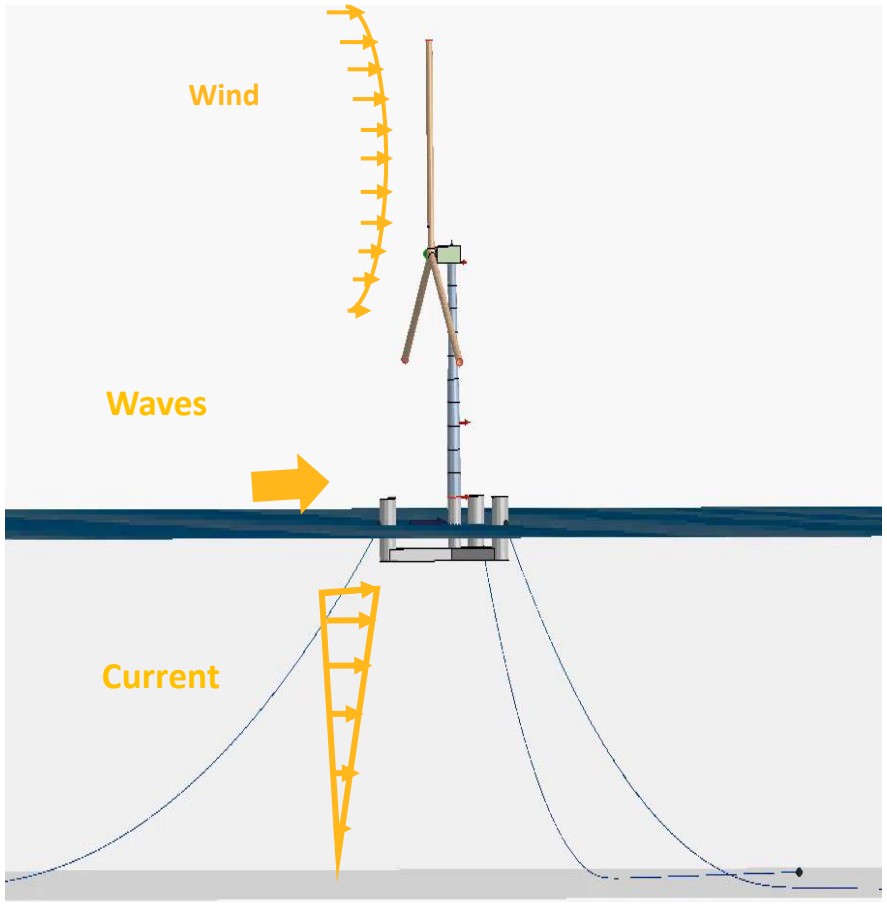
Multi-body

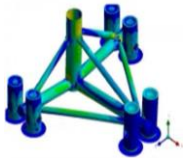


Ansys MOTION

Elasticity

Aero-Hydro-Elastic Coupling System



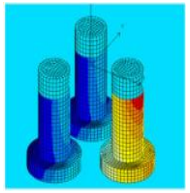


Ansys Mechanical

Detailed Structural Analysis
Fatigue

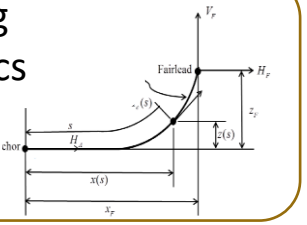
Hydrodynamics

Ansys AQWA



Mooring Dynamics

Ansys AQWA



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Solution – Simulation Driven Digital Twin

Ansys Twin Builder

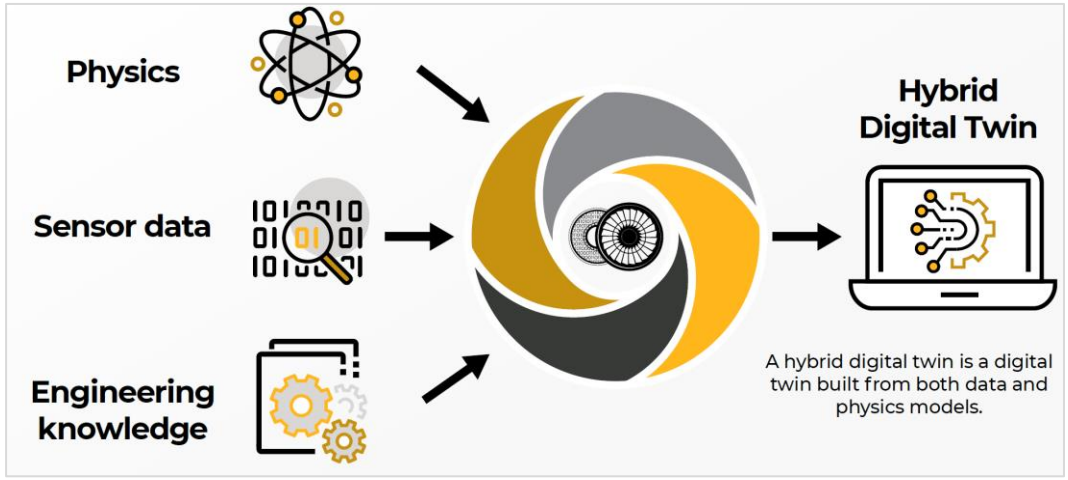
Simulation

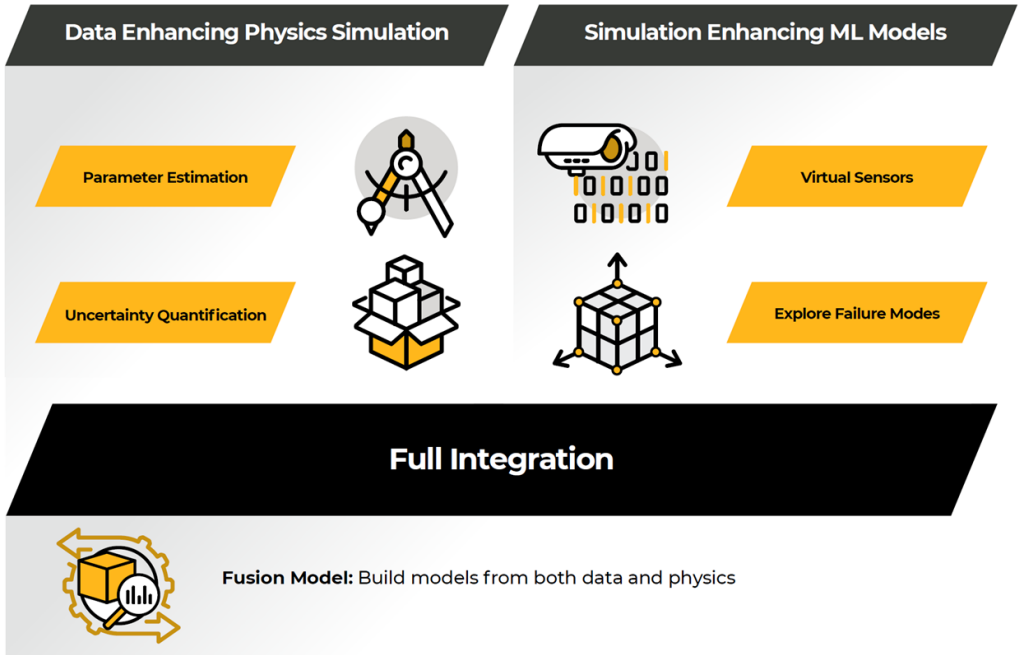
High-fidelity accurate simulation of FOWT

Co-simulation platform

Incorporate sensor data

Build Digital Twin





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Solution – Simulation Driven Digital Twin

Ansys optiSLang

Ansys Twin Builder

Simulation

High-fidelity accurate simulation of FOWT

Co-simulation platform

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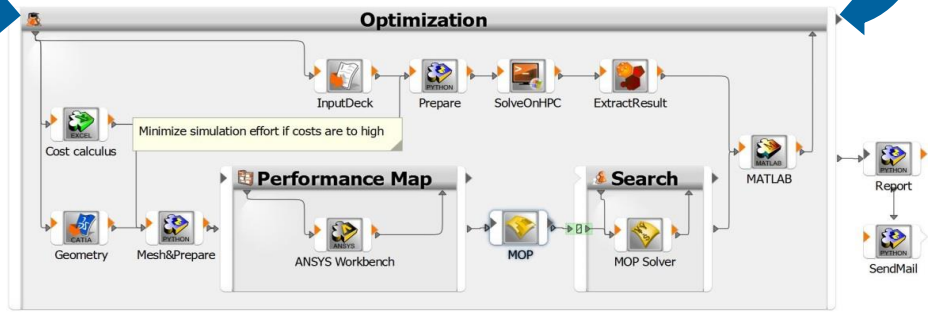
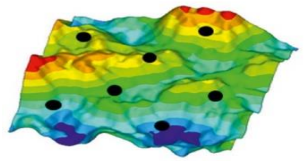
Build Digital Twin

Intelligent DOE to reduce design samples

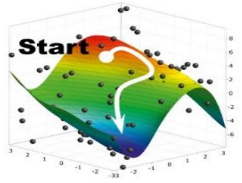
Uncertainty Quantification to determine failure point probabilities



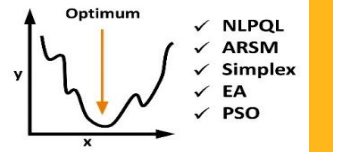
1 Sensitivity analysis for pre-optimization



2 Optimization using MOP



3 Direct optimization with algorithms



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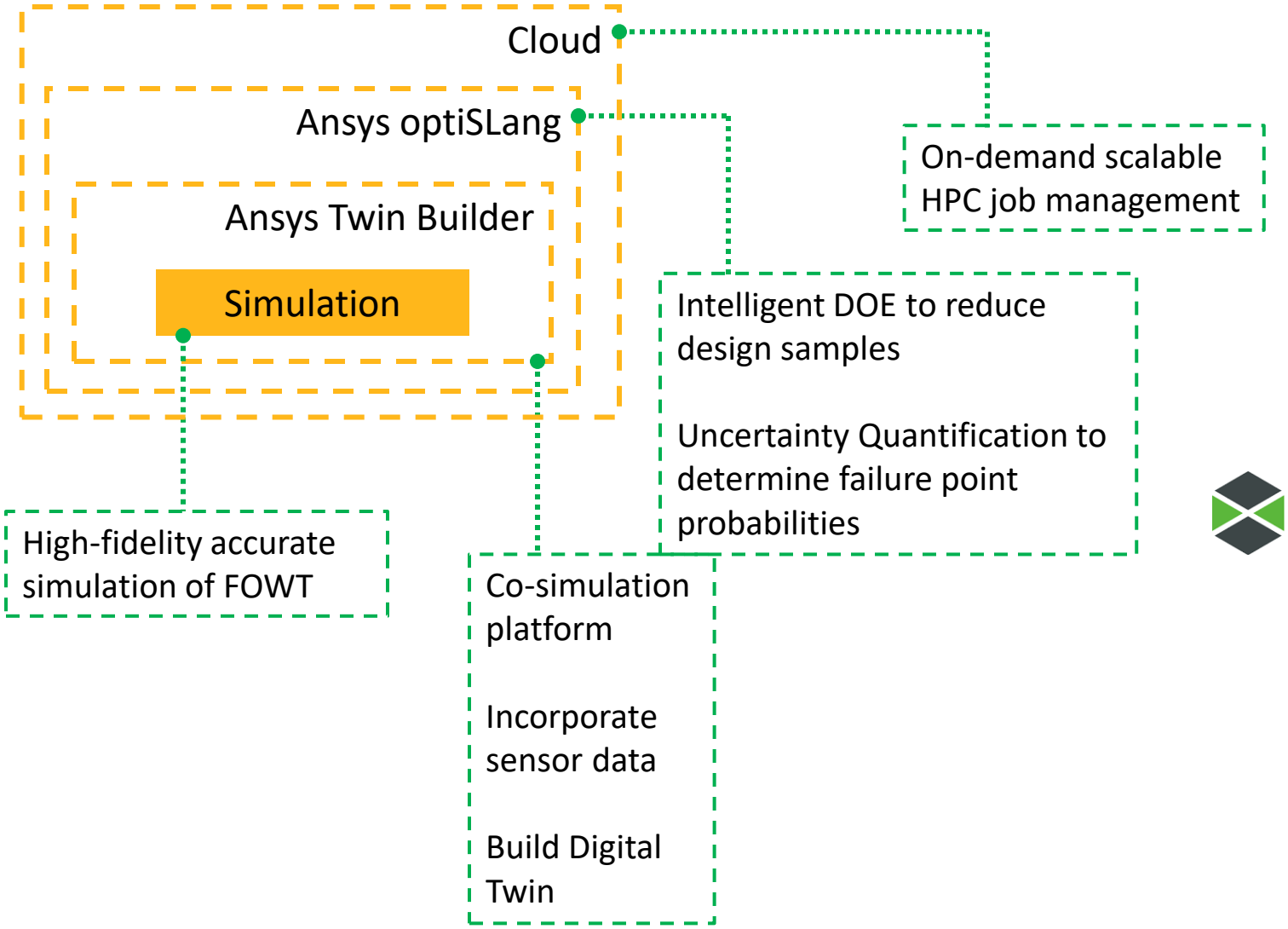
Solution – Simulation Driven Digital Twin



Microsoft Azure

aws

thingworx®

Google Cloud

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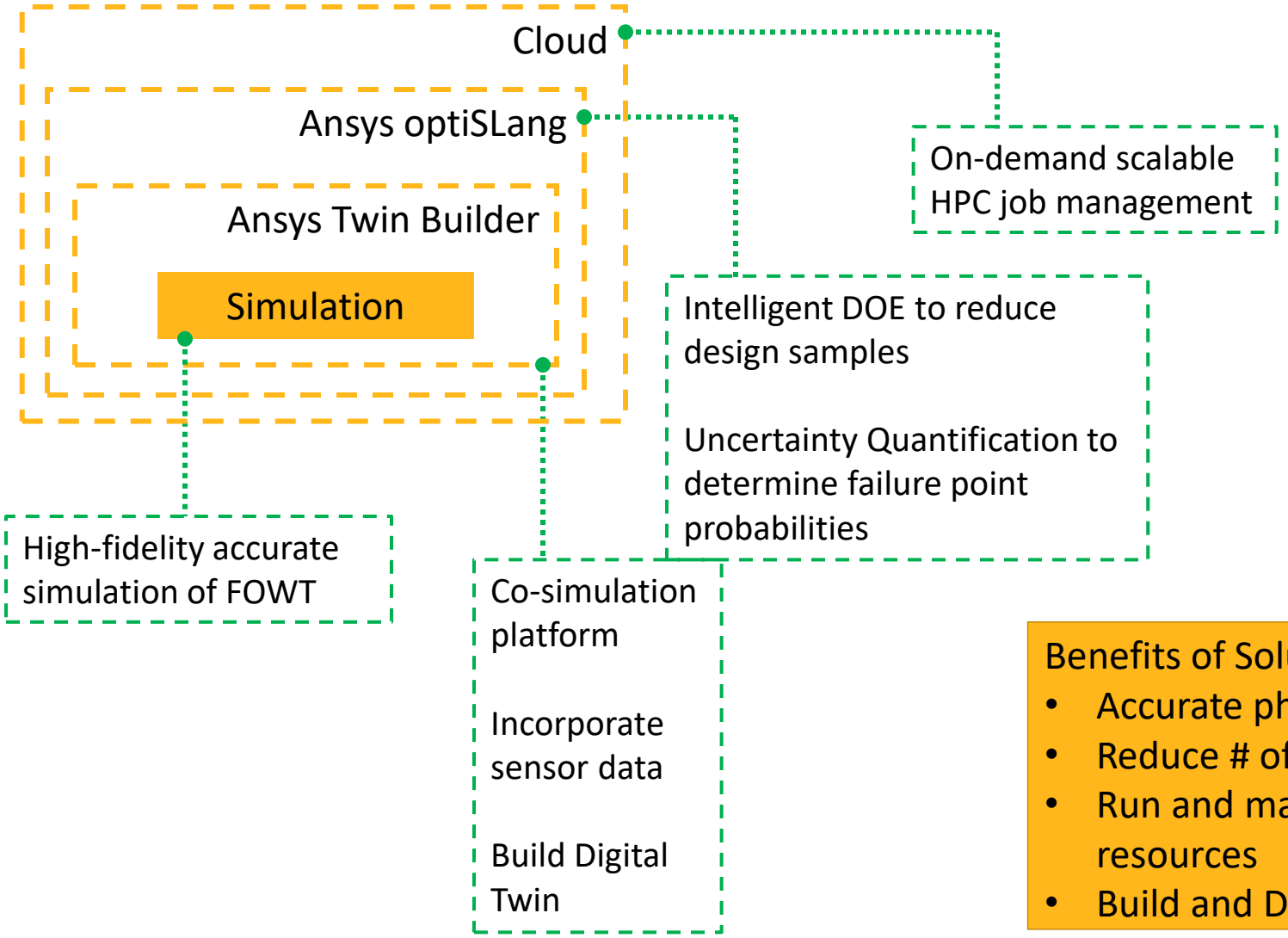
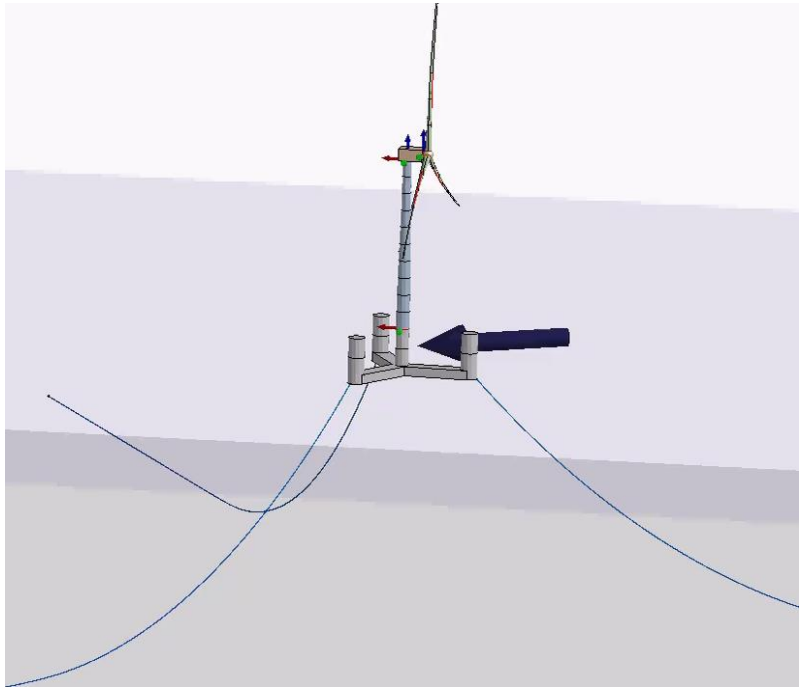
Solution – Simulation Driven Digital Twin





Benefits of Solution:

- Accurate physics models
- Reduce # of simulations by using ROMs and AI.
- Run and manage large simulations w/ off-prem compute resources
- Build and Deploy Digital Twins.

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JIP Proposal

Key benefits for partners and sponsors:

- **Verification of Existing Design Analysis**: Validate floating wind turbine design against real-world data, improving accuracy and reliability.
- **Optimise the use of monitoring technology**: Identify which type of sensors provide value and where to place them.
- **Enhanced Maintenance Strategies**: Use real-time monitoring and predictive insights to minimise downtime and optimise maintenance schedules.
- **Extended Asset Lifespan:** Track fatigue and wear to extend the operational life of platforms, moorings, and cables.
- **Optimised Design and Material Savings**: Reduce over-conservatism in structural designs, cutting steel weight and overall project costs.
- **Scalable and Flexible Solutions**: Adapt the digital twin framework for various floating designs, locations, and future larger turbines.

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Contact us to find out more..

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